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DNA-based artificial chromosomes (SATACs, herein referred to as ACes) and natural chromosomes or fragments of any of these chromosomes.

Please replace the paragraph on page 7, lines 8-13, with the following paragraph:

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Because of the ease with which numbers of events are collected, the monitoring methods provided herein, particularly those based on flow cytometry techniques, provide a method for collection of nucleic acid molecule delivery data that is statistically superior to previous methods of evaluating nucleic acid molecules transfer. The positive values are instrument derived and therefore are not susceptible to judgement errors.

Please replace the paragraph on page 8, lines 11-30, with the following paragraph:

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In particular embodiments, the methods of monitoring delivery and expression of a nucleic acid molecule include the steps of: introducing labelled nucleic acid molecules that encode a reporter gene into cells; detecting labelled cells as an indication of delivery of the nucleic acid into a cell; and measuring the product of the reporter gene as an indication of DNA expression in the cell, whereby delivery and expression of nucleic acid molecules in the cell is detected or determined. The labelled cells can be detected, for example, by flow cytometry, fluorimetry, cell imaging or fluorescence spectroscopy. The label, for example, can be iododeoxyuridine (IdU or IdUrd) or bromodeoxyuridine (BrdU), the reporter gene, for example, can be one that encodes fluorescent protein, enzyme, such as a luciferase, or antibody. The delivered nucleic acid molecules include, but are not limited to, RNA, including ribozymes, DNA, including naked DNA and chromosomes, plasmids, chromosome fragments, typically containing at least one gene or at least 1 Kb, naked DNA, or natural chromosomes. The method is exemplified herein by determining delivery and expression of artificial chromosome

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expression systems (ACes). Any types of cells, eukaryotic and prokaryotic, including cell lines, primary cell lines, plant cells, and animal cells, including stem cells, embryonic cells, and other cells into which delivery of a nucleic acid molecule can occur is contemplated.

Please replace the paragraph beginning on page 13, line 26, through page 14, line 7, with the following paragraph:

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As used herein, cationic compounds are compounds that have polar groups that are positively charged at or around physiological pH. These compounds facilitate delivery of nucleic acid molecules into cells; it is thought this is achieved by virtue of their ability to neutralize the electrical charge of nucleic acids. Exemplary cationic compounds include, but are not limited to, cationic lipids or cationic polymers or mixtures thereof, with or without neutral lipids, polycationic lipids, non-liposomal forming lipids, ethanolic cationic lipids and cationic amphiphiles. Contemplated cationic compounds also include activated dendrimers, which are spherical cationic polyamidoamine polymers with a defined spherical architecture of charged amino groups which branch from a central core and which can interact with the negatively charged phosphate groups of nucleic acids (e.g., starburst dendrimers).

Please replace the paragraph beginning on page 15, line 18, through page 16, line 4, with the following paragraph:

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As used herein, gene therapy involves the transfer or insertion of nucleic acid molecules, and, in particular, large nucleic acid molecules, into certain cells, which are also referred to as target cells, to produce specific gene products that are involved in correcting or modulating diseases or disorders. The nucleic acid is introduced into the selected target cells in a manner such that the nucleic acid is expressed and a product encoded thereby is produced. Alternatively, the nucleic acid may in some manner mediate expression of DNA that encodes a therapeutic product. This product may be a therapeutic compound, which is

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produced in therapeutically effective amounts or at a therapeutically useful time. It may also encode a product, such as a peptide or RNA, that in some manner mediates, directly or indirectly, expression of a therapeutic product. Expression of the nucleic acid by the target cells within an organism afflicted with a disease or disorder thereby provides a way to modulate the disease or disorder. The nucleic acid encoding the therapeutic product may be modified prior to introduction into the cells of the afflicted host in order to enhance or otherwise alter the product or expression thereof.

Please replace the paragraph beginning on page 16, line 24, through page 17, line 8, with the following paragraph:

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As used herein, a reporter gene construct is a DNA molecule that includes a reporter gene operatively linked to a transcriptional control sequence. The transcriptional control sequences include the promoter and other optional regulatory regions, such as enhancer sequences, that modulate the activity of the promoter, or control sequences that modulate the activity or efficiency of the RNA polymerase that recognizes the promoter, or control sequences that are recognized by effector molecules, including those that are specifically induced by interaction of an extracellular signal with a cell surface protein. For example, modulation of the activity of the promoter may be effected by altering the RNA polymerase binding to the promoter region, or, alternatively, by interfering with initiation of transcription or elongation of the mRNA. Such sequences are herein collectively referred to as transcriptional control elements or sequences. In addition, the construct may include sequences of nucleotides that alter translation of the resulting mRNA, thereby altering the amount of reporter gene product.

Please replace the paragraphs beginning on page 19, line 24, through page 20, line 18, with the following paragraphs:

Cationic Compounds

A8 Cationic compounds for use in the methods provided herein are available commercially or can be synthesized by those of skill in the art. Any cationic compound may be used for delivery of nucleic acid molecules, such as DNA, into a particular cell type using the provided methods. One of skill in the art by using the provided screening procedures can readily determine which of the cationic compounds are best suited for delivery of specific nucleic acid molecules, such as DNA, into a specific target cell type.

(a) Cationic Lipids

Cationic lipid reagents can be classified into two general categories based on the number of positive charges in the lipid headgroup; either a single positive charge or multiple positive charges, usually up to 5. Cationic lipids are often mixed with neutral lipids prior to use as delivery agents. Neutral lipids include, but are not limited to, lecithins; phosphatidylethanolamine; phosphatidylethanolamines, such as DOPE (dioleoylphosphatidylethanolamine), DPPE (dipalmitoylphosphatidylethanolamine), POPE (palmitoyloleoylphosphatidylethanolamine) and distearoylphosphatidylethanolamine; phosphatidylcholine; phosphatidylcholines, such as DOPC (dioleoylphosphatidylcholine), DPPC (dipalmitoylphosphatidylcholine), POPC (palmitoyloleoylphosphatidylcholine) and distearoylphosphatidylcholine; fatty acid esters; glycerol esters; sphingolipids; cardiolipin; cerebrosides; and ceramides; and mixtures thereof. Neutral lipids also include cholesterol and other 3 β OH-sterols.

Please replace the paragraph beginning on page 20, line 24, through page 25, line 18, with the following paragraph:

A9 Examples of cationic lipid compounds include, but are not limited to: Lipofectin (Life Technologies, Inc., Burlington, Ont.)(1:1 (w/w) formulation of the cationic lipid N-[1-(2,3-dioleyloxy)propyl]-N,N,N-trimethylammonium chloride

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(DOTMA) and dioleoylphosphatidylethanolamine (DOPE); LipofectAMINE (Life Technologies, Burlington, Ont., see U.S. Patent No. 5,334,761) (3:1 (w/w) formulation of polycationic lipid 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA) and dioleoylphosphatidylethanolamine (DOPE), LipofectAMINE PLUS (Life Technologies, Burlington, Ont. see U.S. Patent Nos. 5,334,761 and 5,736,392; see, also U.S. Patent No. 6,051,429) (LipofectAmine and Plus reagent), LipofectAMINE 2000 (Life Technologies, Burlington, Ont.; see also International PCT application No. WO 00/27795) (Cationic lipid), Effectene (Qiagen, Inc., Mississauga, Ontario) (Non liposomal lipid formulation), Metafectene (Biontex, Munich, Germany) (Polycationic lipid), Eu-fectins (Promega Biosciences, Inc., San Luis Obispo, CA) (ethanolic cationic lipids numbers 1 through 12: $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$, $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$, $C_{55}H_{116}N_8O_2 \cdot 6CF_3CO_2H$, $C_{49}H_{102}N_6O_3 \cdot 4CF_3CO_2H$, $C_{44}H_{89}N_5O_3 \cdot 2CF_3CO_2H$, $C_{100}H_{206}N_{12}O_4S_2 \cdot 8CF_3CO_2H$, $C_{162}H_{330}N_{22}O_9 \cdot 13CF_3CO_2H$, $C_{43}H_{88}N_4O_2 \cdot 2CF_3CO_2H$, $C_{43}H_{88}N_4O_3 \cdot 2CF_3CO_2H$, $C_{41}H_{78}NO_8P$); Cytofectene (Bio-Rad, Hercules, CA) (mixture of a cationic lipid and a neutral lipid), GenePORTER (Gene Therapy Systems Inc., San Diego, CA) (formulation of a neutral lipid (Dope) and a cationic lipid) and FuGENE 6 (Roche Molecular Biochemicals, Indianapolis, IN) (Multi-component lipid based non-liposomal reagent).

Please replace the paragraphs beginning on page 44, line 3, through page 46, line 3, with the following paragraphs:

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For preparation of purified genomic DNA, sorted chromosome samples were brought to 0.5% SDS, 50 mM EDTA and 100 μ g/ml Proteinase K, then incubated for 18 hours at 50°C. 1 μ l of a 20 mg/ml glycogen solution (Boehringer Mannheim) was added to each sample, followed by extraction with an equal volume of Phenol: Chloroform: Isoamyl Alcohol (25:24:1). After centrifugation at 21,000Xg for 10 min, the aqueous phases were transferred to fresh microfuge tubes and were re-extracted as above. 0.2 volumes of 10 M

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NH₄OAC, 1 μ l of 20 mg/ml glycogen and 1 volume of iso-propanol were added to the twice extracted aqueous phases which were then vortexed and centrifuged for 15 minutes at 30,000Xg (at room temperature). Pellets were washed with 200 μ l of 70% ethanol and re-centrifuged as above. The washed pellets were air-dried then resuspended in 5mM Tris-Cl, pH 8.0 at 0.5-2X10⁶ chromosome equivalents/ μ l.

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PCR was carried out on DNA prepared from sorted chromosome samples essentially as described (see, Co *et al.* (2000) *Chromosome Research* 8:183-191) using primers sets specific for EGFP and RAPSYN. Briefly, 50 μ l PCR reactions were carried out on genomic DNA equivalent to 10,000 or 1000 chromosomes in a solution containing 10 mM Tris-Cl, pH 8.3, 50mM KCl, 200 μ M dNTPs, 500 nM of forward and reverse primers, 1.5 mM MgCl₂, 1.25 units Taq polymerase (Ampli-Taq, Perkin-Elmer Cetus, CA). Separate reactions were carried out for each primer set. The reaction conditions were as follows: one cycle of 10 min. at 95°C, then 35 cycles of 1 min. at 94°C, 1 min. at 55°C, 1 min at 72°C, and finally one cycle of 10 min at 72°C. After completion the samples were held at 4°C until analyzed by agarose gel electrophoresis using the following primers (SEQ ID Nos. 1-4, respectively):

EGFP forward primer 5'-cgtccaggagcgcaccatcttctt-3';

EGFP reverse primer 3'-atcgcgcttctcggtgggtcttt-3';

RAPSYN forward primer 5'-aggactgggtggcttccaactcccagacac-3'; and

RAPSYN reverse primer 5'-agcttctcattgctgcgccagggtcagg-3'.

All primers were obtained from Canadian Life Technologies, Burlington, ON.

EXAMPLE 2

Preparation of Cationic vesicles

Vesicles were prepared at a lipid concentration of 700 nmol/ml lipid (cationic lipid/DOPE 1:1) as follows. In a glass tube (10ml) 350 nmol cationic lipid (SAINT-2) was mixed with 350nmol dioleoylphosphatidylethanolamine (DOPE), both solubilized in an organic solvent (Chloroform, Methanol or Chloroform/Methanol 1:1, v/v). Dioleoylphosphatidylethanolamine (DOPE;

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Avanti Polar Lipids, Alabaster, AL) forms inverse hexagonal phases in a membrane and weakens the membrane. Other effectors that may be used are *cis*-unsaturated phosphatidylethanolamines, *cis*-unsaturated fatty acids, and cholesterol. *Cis*-unsaturated phosphatidylcholines are less effective.

The solvent was evaporated under a stream of nitrogen (15 min/ 250 μ l solvent at room temperature). The remaining solvent was removed totally by drying the lipid for 15 min in a desiccator under high vacuum from a vacuum pump. To the dried mixture was added 1 ml ultrapure water. This was vortexed vigorously for about 5 min. The resulting solution was sonicated in an ultrasonication bath (Laboratory Supplies Inc. NY) until a clear solution was obtained. The resulting suspension contained a population of unilamellar vesicles with a size distribution between 50 to 100 nm.

EXAMPLE 3

Preparation of Cationic vesicles via alcoholic injection

In a glass tube (10ml) 350 nmol cationic lipid (Saint-2) was mixed with 350 nmol DOPE, both solubilized in an organic solvent (chloroform, methanol or chloroform/methanol 1/1). The solvent was evaporated under a stream of nitrogen (15 min/ 250 μ l solvent at room temperature). The remaining solvent was removed totally by drying the lipid for 15 min under high vacuum. This was then reconstituted in 100 μ l pure ethanol.

Please replace the paragraphs beginning on page 50, line 8, through page 51, line 4, with the following paragraphs:

Transfection of the cells was performed as follows. The medium was removed from the cells, and the cells were washed twice with HBSS (Hanks balanced salt solution without Phenol Red (Gibco BRL, UK)) at 37°C. Then 500 μ l HBSS at 37°C was added per well, followed by 10 μ l of the freshly prepared vesicle solution (prepared in Example 2) to yield a final concentration of 23.3 nmol/ml.

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Alternatively, the medium was removed from the cells, and the cells were washed twice with HBSS. 500 μ l HBSS/lipid solution at 37°C was added to each well. The HBSS/lipid solution was prepared by adding 1 μ l ethanolic lipid solution (prepared as described above) to 500 μ l HBSS under vigorous vortexing. The plates were then sealed with parafilm tape and shaken gently at room temperature for 30 min. After incubation, ultrasound was applied at an output energy of 0.5 Watt/cm² for 60 sec through the bottom of the plate to the cells. The ultrasound was mediated by an ultrasound gel (Aquasonic 100, Parker, NJ) between transducer and plate. The ultrasound was applied with an ImaRx Sonoporator 100. Immediately after applying ultrasound one GFP chromosome per seeded cell (2×10^5 - 5×10^5) (prepared in Example 1) was added. The plate was then sealed again and shaken gently for 1 h at room temperature. After the incubation 1ml medium (CHO-S-SFM 2 with 10% Fetal Calf Serum, 10000 μ g/ml Penicillin and 10000 μ g/ml Streptomycin Gibco BRL, Paisley, UK) was added to each well and the cells were incubated for 24 h at 37°C. The cells were then washed with medium, 1 ml medium was added, and the cells were incubated at 37° for another 24 h. Detection of expressed genes was then assayed by microscopy or detection of the transferred chromosome by FISH analysis. The negative control was performed in the same way, but with no chromosomes added to the cells.

Please replace the paragraph on page 51, lines 11-17, with the following paragraph:

B. Ultrasound mediated transfection of Hep-G2 cells with Saint-2

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Hep-G2 cells were grown at 37°C, 5% CO₂, in DMEM with 4500 mg/l Glucose, with Pyridoxine/HCl, 10% Fetal Calf Serum, 10000 μ g/ml Streptomycin and 1000 μ g/ml Penicillin. Between 2×10^5 and 5×10^5 cells were plated onto sterile glass slides in a 12 wells plate 24 hours before usage.

Please replace the paragraph on page 51, lines 24-29, with the following paragraph:

C. Ultrasound mediated transfection of A9 cells with Saint-2

A13 A9 cells were grown at 37°C, 5% CO₂, in DMEM with 4500 mg/l Glucose, with Pyridoxine/HCl, 10% Fetal Calf Serum, 10000 µg/ml Streptomycin and 10000 µg/ml Penicillin (GIBCO BRL, Paisley, UK). Between 2 x 10⁵ and 5 x 10⁵ cells were plated onto sterile glass slides in a 12 well plate 24 h before usage.

Please replace the paragraphs beginning on page 52, line 7, through page 54, line 6, with the following paragraphs:

EXAMPLE 7

A flow cytometry technique for measuring delivery of artificial chromosomes

A14 Production cells lines (see Example 1) were grown in MEM medium (Gibco BRL) with 10% fetal calf serum (Can Sera, Rexdale ON) with 0.168 µg/ml hygromycin B (Calbiochem, San Diego, CA). Iododeoxyuridine or Bromodeoxyuridine was added directly to culture medium of the production cell line (CHO E42019) in the exponential phase of growth. Stock Iododeoxyuridine was made in tris base pH 10, Bromodeoxyuridine stocks in PBS. Final concentrations of 0.05-1 µM for continuous label of 20-24 hours of 5-50 µM with 15 minute pulse. After 24 hours, exponentially growing cells were blocked in mitosis with colchicine (1.0 µg/ml for 7 hours before harvest. Chromosomes were then isolated and stained with Hoechst 33258 (2.5 µg/ml) and chromomycin A3 (50 µg/ml). Purification of artificial chromosomes was performed using a FACS Vantage flow cytometer (Becton Dickinson Immunocytometry systems, San Jose, CA). Chromomycin A3 was excited with the primary laser set at 457 nm, with emission detected using 475 nm long pass filter. Hoechst was excited by the secondary UV laser and emission detected using a 420/44 nm band-pass filter. Both lasers had an output of 150 mW. Bivariate distribution showing cell karyotype was accumulated from each sort.

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COO⁺. ACes were gated from other chromosomes and sorted. Condensing agents (hexylene glycol, spermine, and spermidine) were added to the sheath buffer to maintain condensed intact chromosome after sorting. IdU labeling index of sorted chromosomes was determined microscopically. Aliquot (2-10 μ l) of sorted chromosomes was fixed in 0.2% formaldehyde solution for 5 minutes before being dried on clean microscopic slide. Microscope sample was fixed with 70% ethanol. Air-dried slide was denatured in coplin jar with 2N HCl for 30 minutes at room temperature and washed 2-3 times with PBS. Non specific binding was blocked with PBS and 4% BSA or serum for minimum of 10 minutes. A 1/5 dilution of FITC conjugated IdU/BrdU antibody (Becton Dickinson) with a final volume of 60-100 μ l was applied to slide. Plastic strips, Durra seal (Diversified Biotech, Boston, MA) were overlaid on slides, and slides were kept in dark at 4°C in humidified covered box for 8-24 hours. DAPI (Sigma) 1 μ g/ml in Vectorshield was used as counterstain. Fluorescence was detected using Zeiss axioplan 2 microscope equipped for epifluorescence. Minimum of 100 chromosomes was scored for determining % labeled. Unlabeled chromosomes were used as negative control.

The day before the transfection, trypsinize V79-4 (Chinese Hamster Lung fibroblast) cells and plate at 250,000 into a 6 well petri dish in 4 ml DMEM (Dulbecco's Modified Eagle Medium, Life Technologies) and 10% FBS (Can Sera Rexdale ON). The protocol was modified for use with LM (tk-) cell line by plating 500,000 cells. Lipid or dendrimer reagent was added to 1 X10⁶ ACes sorted in ~800 μ l sort buffer. Exemplary protocol variations are set forth in Table 1. Chromosome and transfection agents were mixed gently. Complexes were added to cells drop-wise and plate swirled to mix. Plates were kept at 37°C in a 5% CO₂ incubator for specified transfection time. The volume in a well was then made up to 4-5 ml with DMEM and 10% FBS. Recipient cells left for 24 hours at 37°C in a 5% CO₂ incubator. Trypsinize transfected cells. Samples to be analyzed for IdU labeled chromosome delivery are fixed in cold 70% ethanol and stored at -20°C, to be ready for IdU antibody staining.

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Samples to be grown for colony selection are counted and then transferred to 10-cm dishes at densities of 10,000 and 100,000 cells in duplicate with remaining cells put in a 15 cm dish. After 24 hours, selection medium containing of DMEM and 10% FBS with 0.7 mg/ml hygromycin B, # 400051 (Calbiochem San Diego, CA) is added. Selection medium is changed every 2-3 days. This concentration of hygromycin B kills the wild type cells after selection for 7 days. At 10-14 days colonies are expanded and then screened by FISH for intact chromosome transfer and assayed for beta galactosidase expression.

Please replace the paragraphs beginning on page 55, line 7, through page 56, line 8, with the following paragraphs:

IDU ANTIBODY LABELING

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A standard BrdU staining flow cytometry protocol (Gratzer et al. Cytometry (1981);6:385-393) is used except with some modifications at neutralization step, the presence of detergent during denaturation and the composition of blocking buffer. Between each step samples are centrifuged at 300 g for 7-10 minutes and supernatant removed. Samples of 1-2 million cells are fixed in 70% cold ethanol. Cells are then denatured in 1-2 ml of 2N HCl plus 0.5% triton X for 30 minutes at room temperature. Sample undergoes 3-4 washes with cold DMEM until indicator is neutral. Final wash with cold DMEM plus 5% FBS. Blocking/permeabilization buffer containing PBS, 0.1% triton X and 4% FBS is added for 10-15 minutes before pelleting sample by centrifugation. Add 20 μ l of IdU/BrdU FITC conjugated B44 clone antibody (Becton Dickinson Immunocytometry Systems, San Jose, CA) to pellet and leave for 2 hours at room temperature in the dark with agitation every 30 minutes. Wash cells with block/permeabilization buffer and resuspend in PBS for flow analysis.

FLOW CYTOMETRY DETECTION OF FLUORESCENT IdUrd LABELED ACes

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Percentage of transfected cells containing IdU labeled ACes was determined using a flow cytometry with an argon laser turned to 488 nm at 400 mW. FITC fluorescence was collected through a standard FITC 530/30-nm band pass filter. Cell populations were gated on the basis of side scatter versus forward scatter to exclude debris and doublets. Data were accumulated (15,000 events) to form bivariate channel distribution showing forward scatter versus green fluorescence (IdU-FITC). The fluorescence level at which cells were determined to be positive was established by visual inspection of the histogram of negative control cells, such that approximately 1% appeared in the positive region.

Results:

The transfection delivery results of IdU labeled ACes are set forth in Table 2.

IN THE CLAIMS:

Please replace claims 6, 8, 14, 36, 39, 42, 51, 53, 59, 67, 71, 79, 87, 89, 94, 96, 102, 104, 110, 112, 118, 120, 127, 133, 138, 140, 141, and 143 with the following claims (a marked-up copy of the amended specification is attached to this Amendment):

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6. (Amended) The method of claim 1, wherein the nucleic acid molecule is a natural chromosome, an artificial chromosome, a fragment of a chromosome that is greater than about 0.6 megabase or naked DNA that is greater than about 0.6 megabase.

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8. (Amended) The method of claim 1, wherein the nucleic acid molecule is an artificial chromosome expression system (ACes).

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14. (Amended) The method of claim 12, wherein the delivery agent is a composition that comprises one or more cationic compounds, wherein the compound is selected from the group consisting of N-[1-(2,3-dioleoyloxy)propyl]-N,N,N-trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine

(DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA), $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$, $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$, $C_{55}H_{116}N_8O_2 \cdot 6CF_3CO_2H$, $C_{49}H_{102}N_6O_3 \cdot 4CF_3CO_2H$, $C_{44}H_{89}N_5O_3 \cdot 2CF_3CO_2H$, $C_{100}H_{206}N_{12}O_4S_2 \cdot 8CF_3CO_2H$, $C_{41}H_{78}NO_8P$) $C_{162}H_{330}N_{22}O_9 \cdot 13CF_3CO_2H$, $C_{43}H_{88}N_4O_2 \cdot 2CF_3CO_2H$, $C_{43}H_{88}N_4O_3 \cdot 2CF_3CO_2H$, and (1-methyl-4-(1-octadec-9-enyl-nonadec-10-enylenyl) pyridinium chloride.

36. (Amended) The method of claim 34, wherein the delivery agent is a composition that comprises one or more cationic compounds, wherein the compound is selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine (DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA), $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$, $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$, $C_{55}H_{116}N_8O_2 \cdot 6CF_3CO_2H$, $C_{49}H_{102}N_6O_3 \cdot 4CF_3CO_2H$, $C_{44}H_{89}N_5O_3 \cdot 2CF_3CO_2H$, $C_{100}H_{206}N_{12}O_4S_2 \cdot 8CF_3CO_2H$, $C_{41}H_{78}NO_8P$), $C_{162}H_{330}N_{22}O_9 \cdot 13CF_3CO_2H$, $C_{43}H_{88}N_4O_2 \cdot 2CF_3CO_2H$, $C_{43}H_{88}N_4O_3 \cdot 2CF_3CO_2H$, and (1-methyl-4-(1-octadec-9-enyl-nonadec-10-enylenyl) pyridinium chloride.

39. (Amended) The method of claim 34, wherein the nucleic acid molecule is selected from the group consisting of an artificial chromosome, a artificial chromosome expression system (ACes) and a natural chromosome or a fragment thereof that is greater than at least about 0.6 megabase.

42. (Amended) The method of claim 41, wherein the ultrasound energy is applied to the cell at between about 0.1 and 1 watt/cm², for about 30 seconds to about 5 minutes.

51. (Amended) The method of claim 48, wherein the delivery agent is a composition that comprises one or more cationic compounds, wherein the compound is selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine (DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-

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Covt. propanaminiumtrifluoroacetate (DOSPA), $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$,
 $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$,
 $C_{55}H_{116}N_8O_2 \cdot 6CF_3CO_2H$, $C_{49}H_{102}N_6O_3 \cdot 4CF_3CO_2H$, $C_{44}H_{89}N_5O_3 \cdot 2CF_3CO_2H$,
 $C_{100}H_{206}N_{12}O_4S_2 \cdot 8CF_3CO_2H$, $C_{41}H_{78}NO_8P$, $C_{162}H_{330}N_{22}O_9 \cdot 13CF_3CO_2H$,
 $C_{43}H_{88}N_4O_2 \cdot 2CF_3CO_2H$, $C_{43}H_{88}N_4O_3 \cdot 2CF_3CO_2H$, and (1-methyl-4-(1-octadec-9-
 enyl-nonadec-10-enylenyl) pyridinium chloride.

A23 53. (Amended) The method of claim 48, wherein the nucleic acid molecule is greater than about 1 megabase.

A24 59. (Amended) The method of claim 58, wherein the cationic lipid composition comprises 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA) and dioleoylphosphatidylethanolamine (DOPE).

A25 67. (Amended) The method of claim 66, wherein the cationic compound and the nucleic acid molecule mixture are applied locally.

A26 71. (Amended) The method of claim 65, wherein the nucleic acid molecule is selected from the group consisting of an artificial chromosome, an artificial chromosome expression system (ACes), a natural chromosome or a fragment thereof that is greater than at least about 0.6 megabase.

A27 79. (Amended) The method of claim 73, wherein the delivery agent is a composition that comprises one or more cationic compounds, wherein the compound is selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine (DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA), $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$,
 $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$,
 $C_{55}H_{116}N_8O_2 \cdot 6CF_3CO_2H$, $C_{49}H_{102}N_6O_3 \cdot 4CF_3CO_2H$, $C_{44}H_{89}N_5O_3 \cdot 2CF_3CO_2H$,
 $C_{100}H_{206}N_{12}O_4S_2 \cdot 8CF_3CO_2H$, $C_{41}H_{78}NO_8P$, $C_{162}H_{330}N_{22}O_9 \cdot 13CF_3CO_2H$,
 $C_{43}H_{88}N_4O_2 \cdot 2CF_3CO_2H$, $C_{43}H_{88}N_4O_3 \cdot 2CF_3CO_2H$, and (1-methyl-4-(1-octadec-9-
 enyl-nonadec-10-enylenyl) pyridinium chloride.

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PRELIMINARY AMENDMENT

A28 87. (Amended) The method of claim 85, wherein the compound is selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine (DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA), $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$, $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$, $C_{55}H_{116}N_8O_2 \cdot 6CF_3CO_2H$, $C_{49}H_{102}N_6O_3 \cdot 4CF_3CO_2H$, $C_{44}H_{89}N_5O_3 \cdot 2CF_3CO_2H$, $C_{41}H_{78}NO_8P$, $C_{100}H_{206}N_{12}O_4S_2 \cdot 8CF_3CO_2H$, $C_{162}H_{330}N_{22}O_9 \cdot 13CF_3CO_2H$, $C_{43}H_{88}N_4O_2 \cdot 2CF_3CO_2H$, $C_{43}H_{88}N_4O_3 \cdot 2CF_3CO_2H$ and (1-methyl-4-(1-octadec-9-enyl-nonadec-10-enylenyl) pyridinium chloride.

A29 89. (Amended) The method of claim 84, wherein the cell is a plant cell or an animal cell.

A30 94. (Amended) The method of claim 92, wherein the compound is selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine (DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA), $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$, $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$, $C_{55}H_{116}N_8O_2 \cdot 6CF_3CO_2H$, $C_{49}H_{102}N_6O_3 \cdot 4CF_3CO_2H$, $C_{44}H_{89}N_5O_3 \cdot 2CF_3CO_2H$, $C_{41}H_{78}NO_8P$, $C_{100}H_{206}N_{12}O_4S_2 \cdot 8CF_3CO_2H$, $C_{162}H_{330}N_{22}O_9 \cdot 13CF_3CO_2H$, $C_{43}H_{88}N_4O_2 \cdot 2CF_3CO_2H$, $C_{43}H_{88}N_4O_3 \cdot 2CF_3CO_2H$ and (1-methyl-4-(1-octadec-9-enyl-nonadec-10-enylenyl) pyridinium chloride.

A31 96. (Amended) The method of claim 92, wherein the cell is a plant cell or an animal cell.

A32 102. (Amended) The method of claim 100, wherein the compound is selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine (DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA), $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$, $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$,

A32
C₅₅H₁₁₆N₈O₂.6CF₃CO₂H, C₄₉H₁₀₂N₆O₃.4CF₃CO₂H, C₄₄H₈₉N₅O₃.2CF₃CO₂H,
C₄₁H₇₈NO₈P), C₁₀₀H₂₀₆N₁₂O₄S₂.8CF₃CO₂H, C₁₆₂H₃₃₀N₂₂O₉.13CF₃CO₂H,
C₄₃H₈₈N₄O₂.2CF₃CO₂H, C₄₃H₈₈N₄O₃.2CF₃CO₂H and (1-methyl-4-(1-octadec-9-
CO24
enyl-nonadec-10-enylenyl) pyridinium chloride.

A33
104. (Amended) The method of claim 100, wherein the cell is a plant
cell or an animal cell.

A34
110. (Amended) The method of claim 108, wherein the compound is
selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-
trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine
(DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-
propanaminiumtrifluoroacetate (DOSPA), C₅₂H₁₀₆N₆O₄.4CF₃CO₂H,
C₈₈H₁₇₈N₈O₄S₂.4CF₃CO₂H, C₄₀H₈₄NO₃P.CF₃CO₂H, C₅₀H₁₀₃N₇O₃.4CF₃CO₂H,
C₅₅H₁₁₆N₈O₂.6CF₃CO₂H, C₄₉H₁₀₂N₆O₃.4CF₃CO₂H, C₄₄H₈₉N₅O₃.2CF₃CO₂H,
C₄₁H₇₈NO₈P), C₁₀₀H₂₀₆N₁₂O₄S₂.8CF₃CO₂H, C₁₆₂H₃₃₀N₂₂O₉.13CF₃CO₂H,
C₄₃H₈₈N₄O₂.2CF₃CO₂H, C₄₃H₈₈N₄O₃.2CF₃CO₂H and (1-methyl-4-(1-octadec-9-
enyl-nonadec-10-enylenyl) pyridinium chloride.

A35
112. (Amended) The method of claim 108, wherein the cell is a plant
cell or an animal cell.

A36
118. (Amended) The method of claim 116, wherein the compound is
selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-
trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine
(DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-
propanaminiumtrifluoroacetate (DOSPA), C₅₂H₁₀₆N₆O₄.4CF₃CO₂H,
C₈₈H₁₇₈N₈O₄S₂.4CF₃CO₂H, C₄₀H₈₄NO₃P.CF₃CO₂H, C₅₀H₁₀₃N₇O₃.4CF₃CO₂H,
C₅₅H₁₁₆N₈O₂.6CF₃CO₂H, C₄₉H₁₀₂N₆O₃.4CF₃CO₂H, C₄₄H₈₉N₅O₃.2CF₃CO₂H,
C₄₁H₇₈NO₈P), C₁₀₀H₂₀₆N₁₂O₄S₂.8CF₃CO₂H, C₁₆₂H₃₃₀N₂₂O₉.13CF₃CO₂H,
C₄₃H₈₈N₄O₂.2CF₃CO₂H, C₄₃H₈₈N₄O₃.2CF₃CO₂H and (1-methyl-4-(1-octadec-9-
enyl-nonadec-10-enylenyl) pyridinium chloride.

A37
120. (Amended) The method of claim 116, wherein the cell is a plant
cell or an animal cell.

A38 127. (Amended) The method of claim 124, wherein the cell is a plant cell or an animal cell.

A39 133. (Amended) The method of claim 131, wherein the cell is a plant cell or an animal cell.

A40 138. (Amended) The method of claim 131, wherein the compound is selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine (DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA), $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$, $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$, $C_{55}H_{116}N_8O_2 \cdot 6CF_3CO_2H$, $C_{49}H_{102}N_6O_3 \cdot 4CF_3CO_2H$, $C_{44}H_{89}N_5O_3 \cdot 2CF_3CO_2H$, $C_{41}H_{78}NO_8P$, $C_{100}H_{206}N_{12}O_4S_2 \cdot 8CF_3CO_2H$, $C_{162}H_{330}N_{22}O_9 \cdot 13CF_3CO_2H$, $C_{43}H_{88}N_4O_2 \cdot 2CF_3CO_2H$, $C_{43}H_{88}N_4O_3 \cdot 2CF_3CO_2H$ and (1-methyl-4-(1-octadec-9-enyl-nonadec-10-enylenyl) pyridinium chloride).

A41 140. (Amended) A kit for delivering nucleic acids into cells, comprising: a delivery agent that comprises a composition comprising a delivery agent;

reagents for performing sonoporation or electroporation; and optionally instructions for delivering nucleic acids into cells.

141. (Amended) The kit of claim 140, further comprising a composition comprising an artificial chromosome.

A42 143. (Amended) The kit of claim 142, wherein the compound is selected from the group consisting of N-[1-(2,3-dioleyloxy)propyl]-N,N,N-trimethylammonium chloride (DOTMA), dioleoylphosphatidylethanolamine (DOPE), 2,3-dioleyloxy-N-[2(spermine-carboxamido)ethyl]-N,N-dimethyl-1-propanaminiumtrifluoroacetate (DOSPA), $C_{52}H_{106}N_6O_4 \cdot 4CF_3CO_2H$, $C_{88}H_{178}N_8O_4S_2 \cdot 4CF_3CO_2H$, $C_{40}H_{84}NO_3P \cdot CF_3CO_2H$, $C_{50}H_{103}N_7O_3 \cdot 4CF_3CO_2H$, $C_{55}H_{116}N_8O_2 \cdot 6CF_3CO_2H$, $C_{49}H_{102}N_6O_3 \cdot 4CF_3CO_2H$, $C_{44}H_{89}N_5O_3 \cdot 2CF_3CO_2H$, $C_{41}H_{78}NO_8P$, $C_{100}H_{206}N_{12}O_4S_2 \cdot 8CF_3CO_2H$, $C_{162}H_{330}N_{22}O_9 \cdot 13CF_3CO_2H$, $C_{43}H_{88}N_4O_2 \cdot 2CF_3CO_2H$,